FROM: AFCESA/CES
139 Barnes Drive, Suite 1
Tyndall AFB, FL 32403-5319

SUBJECT: **Engineering Technical Letter (ETL) 97-16: Pavement Marking System for Low Temperature Applications**

1. Purpose. This ETL provides a Commercial Item Description and guide specification for the application of a two-component, low volatile organic compound (VOC) airfield and roadway marking paint suitable for use on Portland cement concrete, bituminous pavements, and plain or vitrified brick traffic-bearing surfaces at temperatures down to -1 ºC (30 ºF).

NOTE: Product and manufacturer names are included in this ETL for the purposes of illustration and do not carry the specific endorsement of the Air Force.

2. Application: Mandatory for all Air Force facilities.

2.1. Authority: AFPD 32-10, *Air Force Installations and Facilities* and AFI 32-1023, *Design and Construction Standards and Execution of Facility Construction Projects.*

2.2. Effective Date: Immediately.

2.3. Expiration: Five years from date of issue.

2.4. Ultimate Recipients: Airfield pavement engineers for the Air Force, Army, and Navy.

3. Referenced Publications.

3.1. American National Standards Institute (ANSI):
- Z87.1-1989, *Practice for Occupational and Educational Eye and Face Protection*

3.2. American Society for Testing and Materials (ASTM):
- D 711-89, *Standard Test Method for No-Pick-Up Time of Traffic Paint*
- D 968-93, *Standard Test Method for Abrasion Resistance of Organic Coatings by Falling Abrasive*
- D 969-85 (1993)e1, *Standard Test Method for Laboratory Determination of Degree of Bleeding of Traffic Paint*
- D 1308-87 (1993)e1, *Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes*
- D 2369-95, *Standard Test Method for Volatile Content of Coatings*

- D 2697-86 (1991)e1, *Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings*
- D 4451-85 (1991)e1, *Standard Test Method for Pigment Content of Paints by Low-Temperature Ashing*
- E 1347-90, *Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry*
- G 53-96, *Standard Test Method for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials*

3.3. U.S. Department of Labor Occupational Safety and Health Administration (OSHA) Regulation:

- 29 CFR 1910.1200, *Hazard Communication*

3.4. Federal Standards and Specifications:

- FED-STD-141, *Paint, Varnish, Lacquer, and Related Materials: Methods of Inspection, Sampling and Testing*
- FED-STD-595, *Colors Used in Government Procurement*
- TT-B-1325C, *Beads (Glass Spheres), Retro-reflective*

4. Requirements.

4.1. Responsibilities.

4.1.1. Bidders. Bidders should visit the site, carefully examine the specifications, and identify all conditions which may affect the work or associated costs. Bidders will identify discrepancies or omissions in the specifications, and immediately notify the Contracting Officer (CO) to obtain clarification prior to submitting a bid. Bidders will submit with their bids the following information, documents, and certifications:

- A list of experience in the application of the two-component, low VOC, methyl methacrylate pavement marking system for runways and roadways.
- A certified history of the Contractor's use of the materials proposed for use in the contract provided by the coating manufacturer.
- Evidence of sufficient financial resources to meet contract obligations.
- A list of materials, equipment, and personnel to be used in the performance of the contract.
- Batch identification for the materials to be applied.
- Complete instructions for materials handling, surface preparation, mixing, thinning, and application prepared by the coating manufacturer, including Manufacturers' Material Safety Data Sheets, brochures, technical data sheets, and bulletins describing coating properties.
- A work schedule.
- A list of safety equipment and precautions required at the job site. The list will include written procedures for handling non-hazardous waste and a chemical composite sample breakdown.

4.1.2. Technical Representative. A technical representative furnished by the manufacturer will assist the CO in ensuring the coating system is properly installed in

accordance with manufacturer's recommendations. The technical representative will provide a written statement that the pavement is ready for installation of the coating system. After coating installation, the technical representative will provide a letter stating installation was performed according to manufacturer's instructions.

4.1.3. Contractor. The Contractor will be responsible for the presence of the technical representative during all pavement preparations and coating operations. The Contractor will be responsible for expenses of the technical representative.

4.1.4. Contracting Officer (CO). The CO will designate the form for reporting bidder financial resources.

4.1.5. Base Civil Engineer (BCE) and Bioenvironmental Engineer (BE). The BCE and Bioenvironmental Engineer will review the bidder's list of safety precautions and equipment for compliance with city, state, and Federal guidelines for containment and waste disposal.

4.2. Coordination of Operations. All coordination during execution of the contract will be with the CO or authorized representative. Any equipment or material temporarily stored will be moved by government personnel upon reasonable notice of at least 5 days of intent to work in the area. Because of unplanned or emergency conditions, the government may require the pavements be returned to government use prior to Contractor completion. In such cases, the government will modify the contract to accommodate reasonable added expense of resuming work when the area becomes available again.

4.3. Safety. The Contractor will provide health and fire safety precautions for Contractor personnel, and will conduct operations in coordination with station operations so that no station personnel are exposed to hazardous amounts of airborne dust particles and solvent vapors. Volatile organic compound (VOC) content must be equal to or less than all applicable Federal, state, and local regulations.

NOTE: Manufacturer's recommendations or requirements of a recognized legal authority take precedence when in conflict with the following paragraph.

Wear protective clothing, gloves, and eye and face protection when applying coatings or when handling liquid materials. Face protective equipment must meet the requirements of ANSI Z87.1.

4.4. Environmental Conditions. Do not apply coatings unless temperatures of both the slab and ambient air are at least -1 °C (30 °F) and no higher than 46 °C (105 °F). If coating must be applied at temperatures outside this range, the coating manufacturer must submit a statement certifying an alternative temperature range and curing time.

4.5. Protection and Cleanup. The Contractor will protect areas adjacent to surface preparation and coating operations, and will protect the work area with barricades,

warning tape, and signs. When work is complete, the Contractor will remove these items and will remove accumulated debris.

4.5.1. Nonpainted Areas. The Contractor will ensure that all markings are properly installed and placed in strict compliance with the drawings and tolerances provided in this specification. Any markings that are improperly placed or fail to meet the requirements of this specification will be removed and reinstalled at the Contractor's expense. Materials used for repairs must be from the same lot and batch as those approved for the performance of the contract, or subjected to the same requirements as those for the contract, and must be approved by the CO or authorized representative before repairs. The Contractor will also ensure all adjacent areas of pavement are protected from splatter, splash, spills, and drips. Any disfigurement will be removed by the Contractor at the Contractor's expense.

4.5.2. Waste Removal.

4.5.2.1. The Contractor will remove from the base all liquid waste material from cleaning operations that cannot be safely flushed into the sewer systems, and coating or solvent residue and containers. The Contractor will analyze a sample of the residue by toxicity characteristic leaching procedure (TCLP). If the material is hazardous, the Contractor will coordinate with the base Environmental Office and dispose of the material as hazardous waste in accordance with all Federal, state, and local regulations.

4.5.2.2. The Contractor will consult with the base Environmental Office and CO or authorized representative to determine an approved disposal method for non-hazardous waste.

4.6. Warranty. The Contractor will warrant the applied pavement marking system for a period of not less than two years against defects such as peeling, loss of adhesion, film softening, or failure from chemicals or fluids used in day-to-day operations. The Contractor will warrant the coating materials free of formulation or manufacturing defects.

4.7. Materials. All components and material used in the two-component pavement marking system must be supplied by the same manufacturer and meet the performance criteria set forth in this section. Materials are designed for application to pavement surfaces by hand or machine. They must provide extremely durable markings for traffic control, airfield marking, legends, and crosswalks.

4.7.1. Types of Paint. Paint supplied must be:

- Type I - Standard, Not Reflectorized
- Type II - Reflectorized

4.7.2. Color of Paint. Paint shall be furnished in the following colors:

Color	FED-STD-595 Color
White	37925
Yellow	33538
Blue	35180
Red	31136
Green	34108
Black	37038

4.7.3. Characteristics. The paint must satisfy the quantitative and curing time requirements in Tables 1 and 2.

Table 1. Quantitative Criteria

Characteristic	Minimum	Maximum	Test Method
Dry opacity, Type I - 0.10 mm (40 mils) wet film thickness	0.99	– –	Fed Test Method Std 141, #4121 Procedure B, Method B
Accelerated weathering, 300 hours, color change -- E^*_{ab} units White Colors	See Note 1	 7 9	ASTM G 53
Bleeding ratio	0.98		ASTM D 969
Color, E^*_{ab} units from standard	– –	6.0	ASTM E 1347
Pigment content, Type I, % weight of solids, mixed components	65	75	ASTM D 4451
Directional reflectance (white only)	85	– –	ASTM E 1347
Water resistance, Type I -- 0.10 mm (40 mils) wet, glass plate, 18 hours water immersion	See Note 2	– –	ASTM D 1308
Abrasion resistance, liters of sand	150	– –	ASTM D 968
Volatile Organic Compound content, grams/liter	– –	150	ASTM D 2369
Volume nonvolatile matter, %, Type I	90	– –	ASTM D 2697

1. Applied to cement-asbestos test panel at a wet film thickness of 0.10 mm (40 mils) for both Type I and Type II materials. Color difference measured from unexposed reference panel. After 300 hours exposure, coating must show no blistering, flaking, or wrinkling. E^*_{ab} defined by ASTM G53.

2. After exposure and 2 hours recovery, paint film must show no change in color or gloss, no blistering, softening, swelling, or loss of adhesion.

Table 2. Curing Time Requirements

	Cure Temperature		
	-1 ºC (30 ºF)	10 ºC (50 ºF)	24 ºC (75 ºF)
Type I, minutes, maximum	50	35	20
Type II, minutes, maximum	65	55	25

NOTE: Drying Time, No Pick-Up - IAW ASTM D 711 when mixed at a ratio of four parts Component A to one part Component B, by volume.

4.7.4. Paint Composition. The Component A resin system will be methyl methacrylate-based. Component B will be benzoyl peroxide in liquid plasticizer. The two components are mixed at a ratio of 4 parts component A to 1 part component B, by volume.

4.7.5. Prohibited Materials. The manufacturer must the product free of mercury, lead, hexavalent chromium, halogenated solvents, and carcinogens, as defined in 29 CFR 1910.1200.

4.7.6. Condition in Container. Paint components must not show excessive settling in a freshly-opened full can, and must be easily remixed with a paddle to a smooth homogeneous state. Paint must show no curdling, livering, caking, lumps, skins or color separation.

4.7.7. Packaging. Packaging and packing must be as specified in the contract or order.

4.7.8. Information and Data Sources.

4.7.8.1. Referenced publications may be obtained from the following addresses:

ANSI Standards — American National Standards Institute
11 West 42nd Street
New York, NY, 10036.

ASTM Standards — American Society for Testing and Materials
1915 Race Street

Philadelphia, PA 19103

NOTE: The issue of ASTM test methods in effect on the date of the solicitation will be used to determine compliance with this ETL.

CFR Superintendent of Documents
U.S. Government Printing Office
Washington DC 20402.

NOTE: CFR documents are for sale on a subscription basis

Federal Standards and Specifications

Federal Supply Service Bureau
Specification Section
Suite 8100, 470 East L'Enfant Plaza SW
Washington, DC 20407.

4.7.8.2. Purchasers should select the preferred options below and include them as ordering data in procurement documents:

- title and date of this ETL
- type required (See 4.7.1)
- color required (See 4.7.2)
- size of container required

4.8. Pre-Award Test Application. The selected coating system should be tested in accordance with paragraphs 4.8.1 through 4.8.4.

4.8.1. Test Area. Before final award of the contract, the Contractor will apply the coating on an area of the pavement designated by the CO or authorized representative. The test area must be representative of existing pavement conditions and representative of the size and type marking required by the contract. The area shall be at least 15 meters (50 feet) long and at least as wide as the widest marking required to be placed in a single pass of the marking vehicle for the performance of the contract.

4.8.2. Procedure. The Contractor will accomplish the test application, including surface preparation and moisture testing. After the test stripes have cured to a "No-Pick-Up" condition (when tested in accordance with ASTM D 711), the Contractor will evaluate the following materials properties in accordance with paragraph 4.11.2:

- adhesion to the substrate
- film properties

- color
- retroreflectivity

During application of the test area, the Contractor must demonstrate ability to comply with application rates specified by the coating manufacturer and paragraph 4.10.2. The Contractor must document the speed and operating pressures required of the equipment to meet the application rates and provide this information to the CO or authorized representative.

4.8.3. Observation. The CO or authorized representative will be present during test application and material evaluation to observe the result obtained on the test stripe, validate the operating parameters of the vehicle(s) and equipment, and accept or reject the test application.

4.8.4. Measure of Performance. The test stripe will be the measure of performance required of the Contractor for the marking project. The Contractor will not proceed with work until the result of the test stripes satisfies the CO or authorized representative.

4.9. Surface Preparation. The Contractor will comply with the surface preparation instructions of the coating manufacturer. Thoroughly clean all surfaces to be coated.

4.9.1. Preparation of Asphalt. Asphalt surfaces must be clean, free of visible moisture or ice, and free of contaminants such as surface oil, dirt, or debris. Remove loose pavement marking materials and contaminants by mechanical means. For good adhesion and durability, make sure the asphalt surface is completely dry. Depending on the mix used and the compaction of newly installed asphalt, up to 30 days of cure may be required before applying the two-component pavement marking material. This curing time allows the tensile strength of the asphalt to increase to the tensile strength of the pavement marking material.

4.9.2. Preparation of Concrete. Portland cement concrete surfaces must be clean, free of visible moisture or ice, and free of contaminants such as curing agents, laitance, or surface oils. Remove loose pavement marking materials and contaminants by mechanical means. Primers, if used, should be as recommended by the manufacturer of the pavement marking material. For good adhesion and durability, make sure that concrete is completely dry. Concrete must have a minimum compressive strength of 20,684 kPa (3,000 psi). Depending upon the type of concrete and curing agent, up to 28 days of cure may be required prior to striping newly installed pavements.

4.10. Application. The Contractor will apply the pavement marking system in accordance with the instructions of the coating manufacturer. Any conflict between these instructions and the general instructions which follow must be resolved by the technical representative at the pre-construction conference.

4.10.1. Equipment. The Contractor will apply the two-component pavement marking material with equipment capable of installing films of 102 millimeters (4 inches) to 1 meter (3 feet) wide and from 0.760 millimeters (30 mils) to 1.5 millimeters (60 mils) thick. Equipment must be capable of dispensing glass beads as required by paragraph 4.10.2.

4.10.2. Retroreflective Glass Beads. The glass beads used in applying Type II material must meet the requirements of Federal Specification TT-B-1325C, Type I. Apply beads at a rate of 1.8 kilograms (4 pounds) to 2.1 kilograms (4.7 pounds) per square meter (10.8 square feet) of surface area marked.

4.11. Quality Assurance.

4.11.1. Materials Compliance Evaluation Criteria.

4.11.1.1. Contractor Certification. The Contractor must certify and maintain substantiating evidence that the product offered satisfies the requirements of this Commercial Item Description, and that the product conforms to the manufacturer's drawings, specifications, standards, and quality assurance practices. In case of conflict regarding conformance, the requirements of this ETL shall take precedence. The government reserves the right to require proof of conformance prior to first delivery and thereafter as may be otherwise provided for in the contract.

4.11.1.2. Market Acceptability Criteria. To ensure serviceability, reliability, and quality of materials, the offeror must have been supplying traffic paint commercially for at least 3 years and must be able to document at least $1 million in annual sales of traffic paint to Federal, state, or local governments.

4.11.2. Paint Application Evaluation Criteria.

4.11.2.1. Adhesion. When cured to a "No-Pick-Up" condition (tested in accordance with ASTM D 711), the paint must resist being lifted from the surface when probed with the blade of a pocket knife or similar tool.

4.11.2.2. Paint Properties. Paint must not wrinkle or blister and must be uniform in thickness, color, texture, and gloss.

4.11.2.3. Color. The Contractor must demonstrate that the coating color matches a Federal Test Standard 595 chip of the specified color number.

4.11.2.4 Retroreflectivity. The Contractor will collect and record readings for white or yellow retroreflective markings to ensure they provide a reasonable level of retroreflectivity for night operations. The minimum acceptable average reading for white markings will be 200 millicandelas per square meter per lux ($mcd/m^2/lx$) (measured with Mirolux 12 Retroreflectometer). The minimum acceptable average for retroreflective yellow markings shall be 175 millicandelas per square meter per lux ($mcd/m^2/lx$). The reading shall be computed by averaging a minimum of 10 readings taken within the test area at random locations.

5. Point of Contact. Mr. Michael D. Ates, HQ AFCESA/CESC, DSN 523-6351, commercial (850) 283-6351, Internet atesm@afcesa.af.mil.

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